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The added value of rail freight transport in Belgium

Anonymous manuscript for review

Abstract

Rail freight transport is facing contradicting realities. Ambitious goals to stimulate this mode of land transport at the expense of the less sustainable and over congested road transport, are going hand in hand with a continuous decrease in usage and modal share statistics. As it is known that a lack of flexibility is holding back the development of this mode, this research wants to evaluate what could be the direct economic impact of rail freight transport in Belgium if these bottlenecks are resolved. By generating three economic indicators, evaluating the added value per unit of workforce, the added value per unit of production and the added value range for the incumbent rail freight operator, the productivity and efficiency of rail freight transport services in Belgium are evaluated and compared with the four main competitors. Results show that for all indicators a positive direct economic impact and an upward trend can be observed, although data collection proves to be challenging and historical data is inexistent or inconsistent due to the absence of joint cost allocation, [which is clearly a point of attention for policymakers. Results also indicate that liberalisation of the rail freight market is stimulating rail freight operators to improve their efficiency by rethinking their business.](#)

Keywords: Rail freight; economic impact; added value; employment; indicators

26 1. Introduction

27 Our starting point for the analysis is the ambitious goal that has been set in the White Paper of the European
28 Commission (2011) to shift 30% of road transport flows over 300 km towards more sustainable modes of
29 transportation such as inland waterways (IWW) and rail transport by 2030. Nevertheless, data on modal split and
30 average yearly growth in Belgium, which is the case country selected for analysis in this paper, are showing a
31 stagnation in the use of rail freight transport (Eurostat, 2019; Meersman et al., 2013) with an average annual
32 growth of 0.4% over the period 2013-2017, compared to an average annual growth for road transport and IWW
33 of respectively 5.6% and 7%. This is paired to a decreasing share in the modal split as a direct consequence of
34 the limited growth figures-. [A similar trend is found at European level, with a decrease in modal share from
35 11.8% to 11.3% between 2013 and 2017 \(Eurostat, 2019\).](#) In addition, a review of literature shows that research
36 in the field of rail freight transport and intermodal economic impact and its motivation -is largely limited to
37 qualitative studies focused on single modes of transportation, without taking into account the full logistics chain
38 perspective¹.

39 Troch et al. (2017) show that five different fields of performance matter: optimal corridor and hub development,
40 economic impact, sustainability, effective market regulation and governance and organization. These indicators
41 reflect the necessary conditions and criteria for developing an innovative intermodal ~~network~~[network in](#) order
42 to stimulate the use of rail freight transport under different market, society and policy-making challenges, in the
43 first place in Belgium, but also applicable to other countries. The current paper will focus on the research and
44 results achieved in the field of economic impact². Therefore, this paper wants to deliver a quantified approach to
45 measure the [direct](#) economic impact of rail freight intermodality by establishing a set of indicators for rail
46 economic impact. [As such, the research question that is addressed in this paper is to check if operational data of
47 an incumbent rail freight operator can be used to evaluate added value performance during a period of transition
48 from state control to independence in an increasingly deregulated market. The incumbent rail freight operator in
49 Belgium, Lineas Group, formerly known as respectively B Logistics, SNCB Logistics and B-Cargo, is observed
50 as a specific company case for this paper.](#)

51 Due to this limited growth and the declining modal split figures for rail freight transport in Belgium, substantive
52 qualitative research ~~is~~[was](#) conducted already to identify the bottlenecks and problems that are holding back an
53 increasing use of rail freight transport in an intermodal chain. [Key insights and contributions on that come from
54 work conducted among others in European programmes Capacity4Rail and Shift2Rail. Next, Islam et al. \(2016\)
55 for instance identify five criteria that shippers take into account when selecting a mode of transport: reliability,
56 cost, availability, safety and security, and environment-friendliness. They also find that rail should then in
57 particular pay attention to its weaker scoring characteristics: lack of system capacity, slow speed, slow
58 acceleration and braking, low loading gauge, low train length, and inefficient transshipment. Furthermore,
59 recent works go a level higher, and involve fleet digitalisation and automation, digital transport management,
60 smart freight wagon concepts, new freight propulsion concepts and business analytics \(Shift2Rail, 2020\).](#)

61 It would be interesting however for stakeholders involved in the decision making process of future rail freight
62 transport development projects, to be able to measure the direct economic impact of these future decisions.
63 According to Meersman et al. (2013) and the European Commission (2014), freight transport growth and
64 economic growth share indeed a strong positive correlation. Understanding and measuring this relationship
65 between rail freight transport and the national economy will ~~help~~[give](#) insight into the complex
66 managerial problems that exist when trying to resolve the bottlenecks and to make rail freight transport
67 development within the intermodal setting a success story (European Environment Agency, 2012).

68 There is a two-way causality between freight transport and economic development: economic growth is one of
69 the key drivers of freight transport, whereas freight transport also contributes to economic growth. Within this
70 paper, the focus is on the latter. The relationship between economic growth and rail freight transport
71 development is here analysed through the creation of added value and the labour factor. The capital factor, such

¹ Scarce exceptions are for instance Darabant et al. (2012), who deal with economic benefits of developing intermodal terminals in Europe, and Jourquin et al. (2014), who deal with demand elasticities for intermodal container transport.

² This paper is based on results achieved in the interdisciplinary BRAIN-TRAINS project, which deals with the analysis and development of new intermodal strategies to increase the use of rail freight transport in Belgium and within the full logistics chain. More information on the BRAIN-TRAINS project and the deliverables of the other fields can be found on <http://www.brain-trains.be/>.

72 as investments, are left out of scope and are subject to further research. In order to evaluate the direct economic
73 impact, ‘added value’ and ‘employment’ are studied at micro-economic or company level. ~~Lineas Group,~~
74 ~~formerly known as B Logistics, SNCB Logistics and B Cargo, is observed as a specific company case.~~ The
75 Belgian rail freight market was liberalized in 2007. Before 2010, the observed company was still holding a
76 market share of up to 90% in Belgium, measured in train-kilometres travelled annually (Deville & Verdun,
77 2012). Due to the absence of publicly available production values of rail freight operators after the liberalization
78 of the market in 2010 (see also Laroche, et al., 2017), an alternative market share for the incumbent operator can
79 be estimated based on the revenues of the different companies. With a revenue market share of 84% in 2015 (B
80 Logistics group, 2015), it is clear that the incumbent rail freight operator still holds a large portion of its
81 dominance on the Belgian rail freight market. As such, calculating the added value and the economic indicators
82 of this company will already give a good indication of the total impact on the Belgian economy.

83 This paper provides more details on the methodology to evaluate direct economic impact, by presenting four
84 different approaches to calculate added value at company level and the corresponding use of three economic
85 indicators in section 2. In addition, focus will be put on the process of data collection as well as the perceived
86 limitations. The results of the economic impact analysis are presented and discussed in section 3. The paper
87 concludes with a number of key recommendations for further scholarly analysis and for rail freight development
88 in section 4.

89 **2. Methodology and data**

90 Direct economic impact of a company can be measured by analysing the parameters ‘added value’ and
91 ‘employment’. These parameters are defined in section 2.1 and will be used in three different economic
92 indicators presented in section 2.2. Section 2.3 provides an overview of four different methods that can be used
93 to calculate company added value and its usage within the economic indicators. In addition, section 2.4 gives
94 more insight into how the necessary data for these calculations is collected, and what is the impact of the
95 limitations of this data, offering an important background for the interpretation of the results in section 3.

96 *2.1. Definitions*

97 Literature shows that ‘added value’ and ‘employment’ are standard parameters to assess the direct economic
98 impact of a transport mode. Vennix (2017) evaluates the economic importance of air transport and airport
99 activities in Belgium over the period 2013-2015 by estimating the parameters ‘added value’ and ‘employment’.
100 Kuipers et. al (2004) uses these parameters to look at the economic impact of road transport. For maritime and
101 port-related activities, Peeters et al. (2002) and Coppens et al. (2007) support the importance of these parameters
102 when making development decisions. Not only in the transport sector are these parameters used to evaluate
103 direct economic impact. SERV (2009) uses ‘added value’ and ‘employment’ to estimate the impact of the
104 economic and financial crisis on the Belgian economy in general. Therefore, it is important to clearly define
105 these parameters.

106 Van de Voorde and Sys (2017) define ‘added value’ as the sum of labour costs, depreciations, other costs and
107 operating results and exploitation subsidies. This approach is taking into account the compensation values for
108 production factors such as labour and capital, in order to obtain the estimated added value as a reward for taking
109 part in the company’s production process. Alternatively, Peeters et al. (2002) define added value as the
110 difference between the value of the produced outputs and the value of the required inputs for this production.
111 These definitions indicate that added value at a company level estimates the monetary amount that is added to
112 purchased services and goods by adding production factors such as labour and capital. Therefore, employment is
113 also an integral part of added value. Both approaches will be followed and compared in this study.

114 *2.2. Economic indicators*

115 To quantify and measure the direct impact of the added value created by a company on the economy, the
116 parameters ‘added value’ and ‘employment’ can be used in three different indicators. These indicators are
117 specified by Vanstraelen (2005).

118

119 A first indicator (1) to evaluate the direct economic contribution of a company is the added value per full-time
120 equivalent employee (FTE):

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$$\text{Added value per FTE} = \frac{\text{Added value (EUR)}}{\text{Average workforce (FTE)}} \quad (1)$$

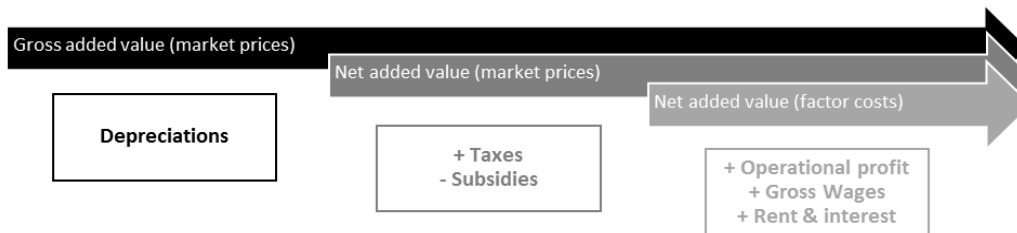
122 A second indicator (2) to assess the productivity of a company is the added value per production unit. For the rail
 123 freight sector, production units can be expressed in ton-kilometers (tkm) or train-kilometers (trainkm). Within
 124 this paper, the main production value will be expressed in tkm:

125
$$\text{Added value per production unit} = \frac{\text{Added value (EUR)}}{\text{Total production (tkm)}} \quad (2)$$

126 A last indicator (3) is the added value range of a company. This indicator calculates the contribution of added
 127 value to the production value expressed in revenue. This is reflecting the level of vertical integration of a
 128 company, or the level of ownership over the established production.

129
$$\text{Added value range} = \frac{\text{Added value}}{\text{production value (revenue in EUR)}} \quad (3)$$

130



131 **Fig. 1 Added value—bottom-up approach**
 132 **Source: own composition based on Welten (1996) and Bloemen (2017)**

133 **2.3. Added value methodology**

134 To calculate these economic indicators from the previous section, first the added value of a company needs to be
 135 estimated. In this paper four different approaches will be explored. Two main methods are the bottom-up
 136 approach and the top-down approach, following the definitions of Van de Voorde and Sys (2017) and Peeters et
 137 al. (2002). In addition, two alternative top-down approaches will be evaluated: a simplified top-down calculation
 138 presented by Van Dijk (2017) and an adapted top-down calculation by the authors.

139 **2.3.1. Bottom-up approach**

140 This approach is accumulating the ~~retribution~~ values ~~for of~~ the different production factors to obtain the added
 141 value, shown in figure 1. The operational profit exists due to the difference between the cost of production and
 142 the purchasing value and is therefore an integral part of the created added value by the company. However this
 143 does not mean that a positive added value goes hand in hand with a positive operational profit, as also the gross
 144 wages, rent and interest should be taken into account (Welten, 1996). Even though these amounts are
 145 expenditures for the company, they are generating economic impact as they are providing financial resources to
 146 other beneficiaries such as the paid employees. Therefore, these figures are also an integral part of the created
 147 added value and can be complemented with a positive or negative operational profit. In that sence, added value
 148 figures can function as an indicator of profitability, and therefore also be used for analyzing competitive
 149 performance of operators. Depreciation values for replacing capital factors such as buildings and machines
 150 should be added to obtain the gross added value. When the added value is corrected for price increasing taxes
 151 and price lowering subsidies, the net added value is obtained in factor costs or market prices (Bloemen, 2017).

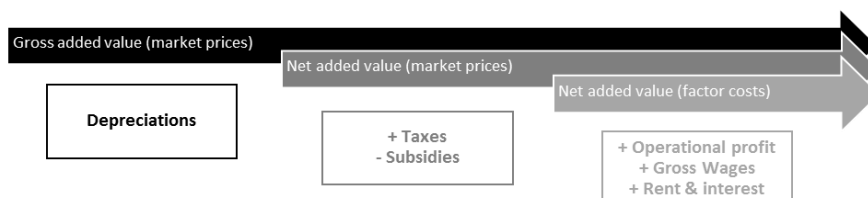


Fig. 1 Added value – bottom-up approach
Source: own composition based on Welten (1996) and Bloemen (2017)

2.3.2. Top-down approach

Contrary to the bottom-up approach, the top-down approach is not summing the different components of added value, but starts from the total operating income and subtracts all elements that are not a part of the added value creation. Figure 2 shows which factors that are included in this approach provided by the National Bank of Belgium (NBB, 2007). It should be noticed that depreciations are not subtracted, and as such a gross added value in factor costs or market prices is obtained.

Alternatively, Van Dijk (2017) proposes an alternative simplified top-down approach to calculate the added value of a company. In their definition, the operational operating income (code 70/74 on the income statement in the annual report) is only lowered by the cost of the intermediary usage of goods and services (code 60/61), purchased for the production of this output. For the purpose of this research, an alternative top-down approach will be evaluated, based on figure 2 but with an additional deduction of the provisions for risks and costs (code 635/7). It can be argued that these provisions for risks and costs are only used in exceptional cases such as the restructuring of a company and only as an accounting transaction. Therefore, this amount is not contributing to the added value of a company and should not be taken into account as such.



Figure 2 Added value – top-down approach
Source: own composition based on NBB (2007)

2.4. Data collection and limitations

In order to calculate the added value and the corresponding economic indicators, data collection is necessary. As mentioned before, focus in this paper will be put on the company case of the incumbent rail freight operator in Belgium. Before liberalization in 2010, Lineas was known as SNCBSNCBSNCB Logistics and part of the SNCBSNCBSNCB group. This national main organization captured not only rail freight services, but also all passenger services and infrastructure maintenance on the Belgian rail network. Therefore, only limited data is available in terms of clean rail freight operations. This data is collected from the statistical yearbooks for the period 1990-2009 and historical data obtained from interviews. In 2010, after liberalization, rail freight services were split from the national group and started to publish their own annual accounts. As of this year, detailed information can be collected from the annual accounts of the incumbent rail freight operator.

Due to the absence of detailed information on taxes and subsidies, this research will focus on gross added value in factor costs and not market prices. Although subsidies are present within the rail freight sector, this data is scarce and not always transparent (Lineas, 2017). Subsidies to support container transport via rail, as a measure to increase competitiveness with road transport, are only eligible to freight forwarders and cannot be claimed by rail freight operators directly (Counet, 2017). Nevertheless, in reality, these subsidies are often impacting market prices and are therefore incorporated within the operational income. By calculating added value for the four observed approaches in factor costs, consistency is maintained and the results can be compared.

For the pre-liberalization period, the required data is only available for all activities performed within the SNCBSNCBSNCB group. Only general estimations exist for operational freight costs and revenues. Therefore, no detailed rail freight added value can be calculated for the period before 2010. Consequently, this research will focus on the period after liberalization in 2010, calculating the added value and the economic indicators for the incumbent rail freight operator in the next section. For the simplified top-down approach by Van Dijk (2017), some estimations can be made for the period 2005 – 2009. As only the purchases of services and goods is required, this number can be estimated based on the assumption that the share of total operational costs within the SNCB group allocated to freight, is equal to the share of input purchases for the production of these freight services. As this assumption is not irrational but does bring a limited amount of distortion, results are to be interpreted with caution. For the remaining observed historical data, some qualitative conclusions will be discussed.

It should be addressed that Belgium, due to its geographical position in Europe and its limited territory, is heavily influenced by transitional traffic from and towards The Netherlands, Germany and France. As a

consequence, rail freight transport in Belgium as well as the observed incumbent operator have an international cross-border character. This has two main implications. First of all, on Belgian territory, there are flows that are increasingly operated by foreign incumbents, which is an aspect of additional competition. Second, quite some of the flows on Belgian territory are induced by developments abroad, both positively and negatively. Positively by the connections with foreign seaports for instance. Negatively given the fact that foreign connections (e.g. the Betuweline in The Netherlands) get established or improve, shifting rail traffic or even entire port chains away from Belgium to other countries. This should all be taken into account when reflecting on the observed results within this paper, but offers at the same time a window of opportunity to further investigate the international relevance of the described methodology and the obtained results in future research.

3. Results and discussion

This section presents and discusses the results. First, focus will be put on the observations of the parameters ‘added value’ and ‘employment’ of the incumbent rail freight operator. Secondly, the calculation of the economic indicators for the incumbent rail freight operator will be discussed. Finally, a comparison will be made with the main competitors of the incumbent rail freight operator, based on the simplified top-down approach. As production values for these competing companies are not available, it is not possible to calculate the second indicator. Nevertheless, the observed data allows comparing the evolution for the ~~other~~remaining two economic indicators.

3.1. Added value and employment

Looking at the employment values in table 1, it can be seen that four shifts occur over time, indicated by a double line. Each of these shifts have historical reasons and should be taken into consideration when analysing the observed data. During the nineties, B-Cargo was a separate entity providing the freight activities within the SNCB group. Only the actual workforce fully dedicated to this entity is taken into consideration in the statistical data publications. Nevertheless, other human resources within the company, for example managing the signal boxes, are also providing freight services but are not taken into account. As such, due to the absence of a correct joint cost allocation, only an average of 0.5% of the total workforce is assigned to the freight centre. As of 1998-1999, a reorganization introduced the use of 13 cost centres and activity centres (Counet, 2017). This explains the first limited increase in FTE, as more human resources outside of B-Cargo are also allocated to the freight service activities. Nevertheless, allocation took place based on the main employee’s activity, and the FTE was allocated to this activity centre in full, which only caused a limited shift of human resources towards freight services.

As a consequence, for example employees providing rail track maintenance, were allocated to the activity centre ‘infrastructure’ even though they were providing services for both passenger and freight activities. As such, joint costs were still not allocated properly and only 1% of the total workforce was allocated to freight, whereas 20% of total revenues result from these freight activities. As of 2004, a study by Boston Consulting Group (2001) led to another reorganization with six new core activity centres, focussing on ‘passengers’, ‘mobility’, ‘Europe’, ‘freight’, ‘technical’ and ‘production and general services’ (SNCB 2005). This resulted in a significant increase in allocated FTE to freight services as can be seen in table 1. The share of freight-allocated human resources rose to a more acceptable 14%. After liberalization in 2010, freight activities became an independent organization outside of the SNCB structure. As such, human resources were also progressively transferred to this separate entity in order to execute all freight services with dedicated employees. This explains the substantial drop in FTE, followed by a gradual increase over the last years. As this period of transition is now concluded, any future increase in workforce points towards a growth in freight activities of the incumbent rail freight operator.

Table 1. Employment (FTE)

Year	Freight Employment (FTE)	Year	Freight Employment (FTE)	Year	Freight Employment (FTE)	Year	Freight Employment (FTE)
1993	97 FTE	1999	470 FTE	2005	2 773 FTE	2011	344 FTE
1994	234 FTE	2000	459 FTE	2006	2 679 FTE	2012	481 FTE
1995	263 FTE	2001	461 FTE	2007	2 603 FTE	2013	505 FTE
1996	284 FTE	2002	453 FTE	2008	2 500 FTE	2014	659 FTE
1997	274 FTE	2003	449 FTE	2009	2 195 FTE	2015	680 FTE

1998	267 FTE	2004	2 853 FTE	2010	228 FTE
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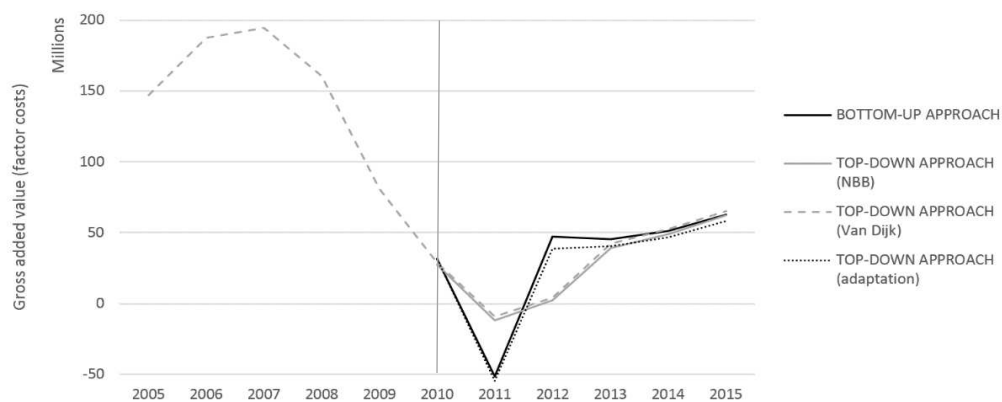
243 Source: Own composition based on SNCB (1990 -2009) and B Logistics (2011 – 2016)

244 Due to the absence of a correct joint cost allocation for freight services, no data is available to calculate added
 245 value according to three out of the four defined approaches. Nevertheless, for the historical period, three
 246 additional observations can be mentioned. First, the share of freight in total revenue drops over the observed
 247 period from 30% to 20%, mainly due to a rise in total revenue and a stabilization of freight revenues (SNCB,
 248 1990-2009). During the economic and financial crisis in 2008 and 2009, total revenue remained constant,
 249 however income from freight activities dropped significantly resulting in a freight share of only 14%. This also
 250 indicates a significant growth in passenger activities during the crisis years. A second observation is the share of
 251 freight activities in total operational costs, accounting to an average of 22% and dropping to 17% during the
 252 crisis. This is higher than the freight share of operational income, and as such freight activities can be considered
 253 to be onerous. In addition, it should be taken into account that no correct joint cost allocation has taken place for
 254 freight activities, due to which the share of freight in total operational costs is estimated to be even higher in
 255 reality. A third observation is that the decrease in added value of the incumbent rail freight operator does not
 256 only run simultaneously with the start of the crisis, but also with the liberalization of the Belgian rail freight
 257 market, indicating that new competitors might have taken over specific high added-value business flows.

258 Looking at the added value, figure 3 gives an overview of the four defined approaches for the incumbent rail
 259 freight operator. It can be observed that gross added value in factor costs is positive for all four approaches as of
 260 2012. The gap in 2011 can be explained due to the transition period from an entity within a public group towards
 261 an independent company, be it with the national SNCB group as a major shareholder. As of 2015, B Logistics
 262 became a true private company, with Argos Soditic becoming a private shareholder of 68.9% (Argos Soditic,
 263 2015). Furthermore, it can be seen from figure 3 that all four approaches show a positive trend for the gross
 264 added value in factor costs. Additionally, it can be concluded that the bottom-up approach (Bloemen, 2017) has a
 265 similar trend compared to the adapted top-down approach, making the latter an easy and consistent alternative
 266 for the data-intensive bottom-up approach. Due to the correction for provisions for risks and costs, the top-down
 267 approach is corrected for the volatile evolution of these provisions during the transition years 2011 and 2012.
 268 The standard top-down approach by NBB (2007) and the simplified approach by Van Dijk (2017) also show
 269 similar results, indicating that the purchases of services and goods as inputs to the production are indeed the
 270 major factor in determining the gross added value in factor costs. As of 2013, it can be concluded that all four
 271 methods are converging into in similar outcomes and are following the same positive upward trend. These results
 272 correspond with the actions taken by B Logistics as from 2010 to become a healthy, profitable and growing
 273 independent rail

274 Figure 3 Gross added value of the Belgian incumbent operator (factor costs in mio EUR)
 275 Source: own composition based on SNCB (2005 – 2009) and B Logistics group (2011 – 2016)

276
 277 freight operator in Belgium (Lineas, 2017). Gross added value figures before 2010 are significantly higher, but
 278 dropping rapidly during the financial and economic crisis and the increased competition due to the Belgian
 279 market liberalization.



280 Figure 3 Gross added value of the Belgian incumbent operator (factor costs in mio EUR)
 281 Source: own composition based on SNCB (2005 - 2009) and B Logistics group (2011 - 2016)

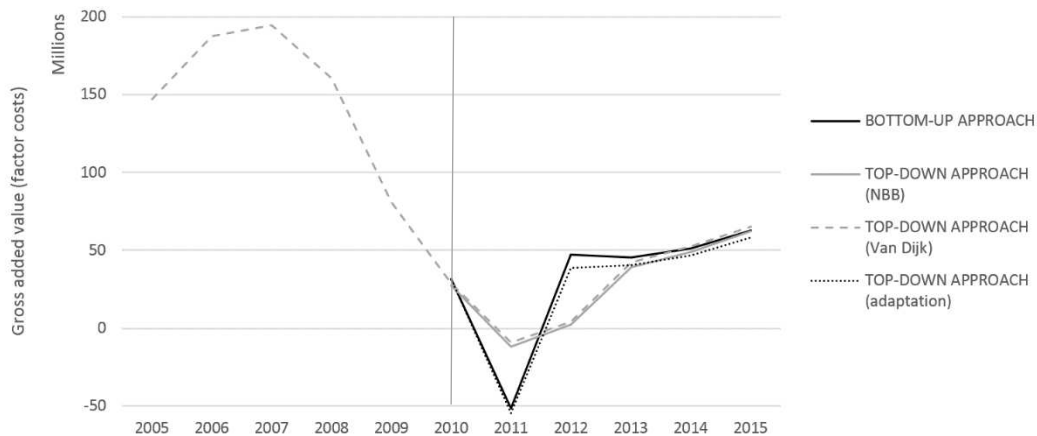


Figure 3 Gross added value of the Belgian incumbent operator (factor costs in mio EUR)
 Source: own composition based on SNCB (2005–2009) and B Logistics group (2011–2016)

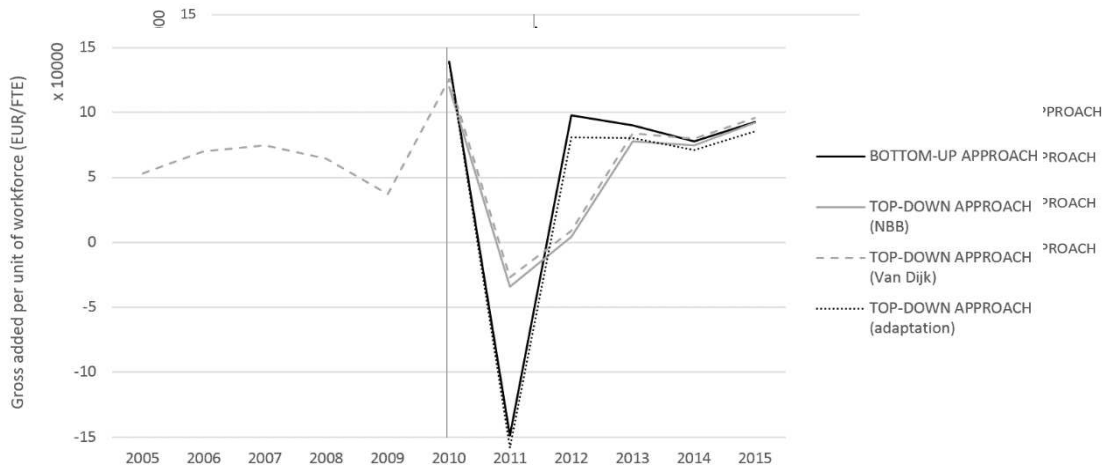
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Even though these figures have to be taken into consideration with care due the assumption made above, it could be considered that rail freight transport activities in Belgium are still recovering from the aftermath of these difficult years. However, in order to better understand and evaluate these figures on the added value, a relative comparison to the ~~used~~ workforce employed, the actual production and the obtained revenue is necessary to put these figures into perspective. This will be done in the next section.

3.2. Economic indicators

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It is difficult to draw definite conclusions from absolute added value figures on the direct economic impact of a company, without comparing them to the actual input received and outputs created to obtain them. Therefore, the calculated gross added value figures are used to calculate the three economic indicators. A first economic indicator is the relation between the acquired added value and the used workforce to obtain it (1). Fig. 4 shows the results for the four different approaches. From the simplified top-down approach, it can be seen that the historically high absolute gross added value figures are more spread when compared with the used workforce. This can be explained by the big contribution of gross wages towards the calculating of added value. In addition, the gross added value per unit of workforce of the incumbent operator even surpasses the historic indicator values by 2015, indicating that the incumbent operator recovered from its late noughties challenges and is continuing its path to become a profitable, efficient and competitive company, increasing its contribution towards the Belgian economy. This is clearly an important element of flexibility. Comparing the four different approaches, similar conclusions as with the gross added value in figure 3 can be made concerning the trend evolution. The significant drop in 2011 and the rapid rise in 2012 can be explained due to the transition from a public towards an independent organization. When making abstraction of this transition period, a slightly positive trend of this economic indicator can be observed, indicating that added value is growing at a faster rate compared to the increase in workforce, resulting in an increased efficiency.



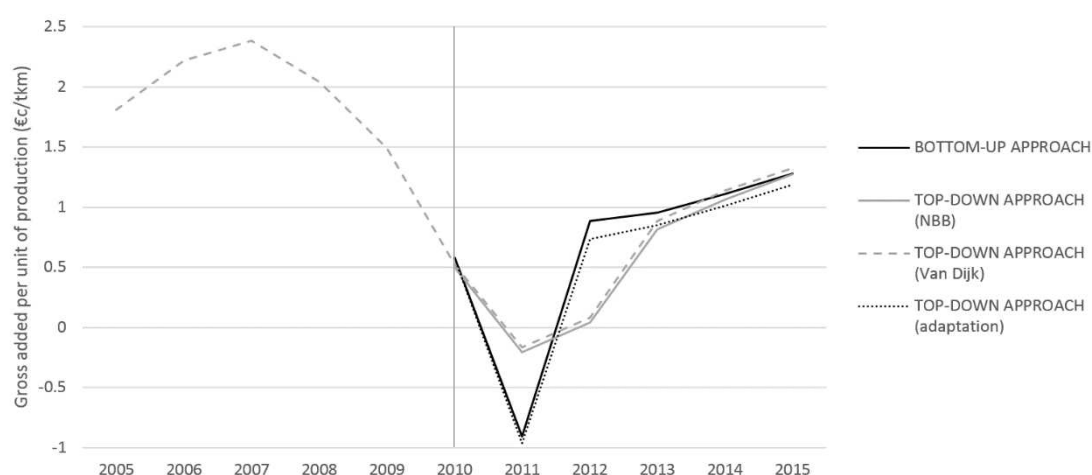
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Figure 4 Gross added value per unit of workforce (EUR/FTE)
Source: own composition based on SNCB (1990 -2009) and B Logistics group (2011 – 2016)

It should be remarked that Lineas is currently using seconded employees from the national rail service operator and the infrastructure manager. These employees are not on the direct payroll and are as such not taken into account into the employment figures in table 1 and the economic indicator in Figure 4. The wage of these employees is considered a service cost within the original analysis. Nevertheless, they are fully dedicated to work activities performed by Lineas. As such, it is an interesting case to analyse the results if these employees are also taken into consideration and their service cost is transformed into wages and as such directly contributing to the generated added value by the observed organization. The study shows that the trends of the four approaches to calculate the added value generated by the rail freight sector remain similar to the conclusions above. However, taking into account the allocated workforce results in a lower economic indicator, dropping on average by 10,000 EUR/FTE. This could be explained by the observation that added value is only increased by the additional wages of the allocated employees, whereas remaining added value generated by the activities of these employees has been already taken into account previously.

Figure 5 shows the gross added value per unit of production, expressed in Eurocent per tkm (2). Foremost, some general conclusions on production values are to be observed. First, production values have experienced an upward trend until the financial and economic crisis in 2008, dropping by almost one third in 2009. After liberalization, production values continue to decline until 2014, after which an increase is observed in 2015 and 2016. Second, the share of intermodal rail freight production is increasing from 12.04% in 1990 to almost 40% in 2016, indicating the increasing importance of rail freight intermodality within the logistics chain. And last but not least, absolute volumes in terms of Metrie Tons (MT)tonnes are decreasing over the historic period observed (1990 – 2004), indicating that rail freight transport in Belgium is being executed over longer distances, increasing its profitability. This is important as for short distances, handling activities are becoming relatively more important and might have an effect on the obtained added value results. Observing figure 5, it can be concluded that indeed a high added value per unit of production was obtained before 2007. However, during the period 2008-2011, the economic indicator rapidly declines due to the economic and financial crisis, the transition towards an independent company and the increasing competition. These new competitors could have used strategies to carefully address niche markets with high added value flows. The decline of the indicator reveals that, although production values are decreasing as of 2008, gross added value is decreasing more quickly, resulting in a decrease of the values of the economic indicator. A decline in rail freight transport therefore has a proportionally high negative impact on its added value. After the transition period, a positive trend can be observed, indicating that, despite the still declining production, more added value was generated and the incumbent rail freight operator was indeed stimulated to rethink its business. Even with the rise in tkm in 2015, a positive evolution of this indicator is maintained, indicating a growing economic impact of its business. It will be interesting to see the evolution of this indicator in the next years as traffic and innovation continue to increase.



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Figure 5 Gross added value per unit of production (Eurocent/tkm)
Source: own composition Source: own composition based on SNCB (1990 - 2009) and B Logistics group (2011 - 2016)

The final economic indicator results for the incumbent rail freight operator are shown in figure 6. The gross added value range evaluates the ratio between the gross added value and the obtained revenue through the

351 executed production (3). Unless a significant change in pricing strategy takes place, revenue is generated by
 352 these production values in such extent that similar results compared to figure 5 can be perceived. More
 353 importantly, this indicator gives more insight in the vertical integration of the incumbent rail freight operator.
 354 Vertical integration is the level to which a supply chain is owned by an observed organization (Vanstraelen,
 355 2015). A vertical integration of 100% would imply that every EUR of revenue is resulting in one EUR of added
 356 value. As such, the company would completely own its supply chain, which is of course not realistic. Figure 6
 357 shows that vertical integration was significantly higher before the challenging years. However, it should be taken
 358 into consideration that joint costs were not allocated optimally before liberalization in 2010, and an assumption
 359 was used to obtain estimations of the gross added value in this period, resulting in a probable overestimation of
 360 the gross added value figures. Nevertheless, the declining trend is still a meaningful indication that vertical
 361 integration has been decreasing until 2011 and is slowly recovering up until today. Although production and
 362 revenue values were still decreasing until 2015, this once again indicates the recovery of the incumbent rail
 363 freight operator after the transition to an independent organization, being more than just an organizer of rail
 364 freight transport services. This is another element of increased flexibility demonstrated by the incumbent
 365 operator: actively chasing for cargo, and proposing new products. These rail freight activities increasingly
 366 contribute more added value over the past few years.
 367

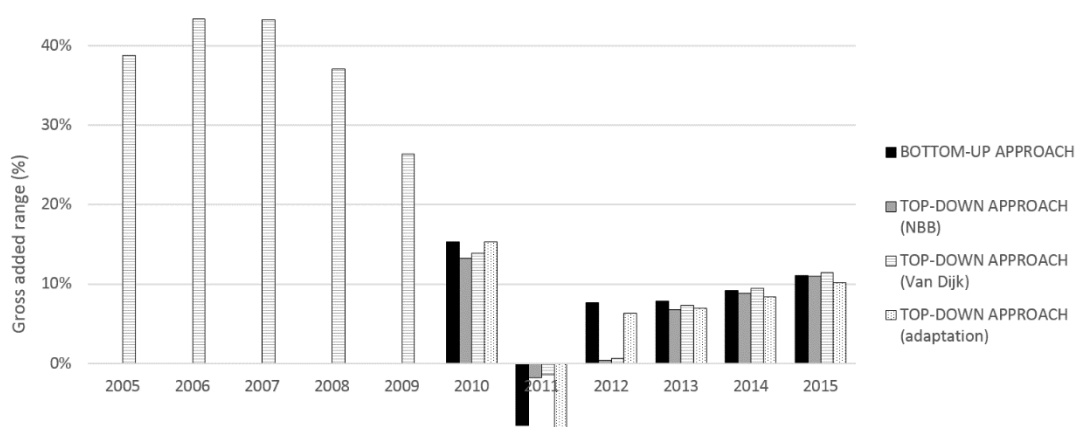


Figure. 6 Gross added value range (%)

Source: own composition based on SNCB (1990 - 2009) and B Logistics group (2011 - 2016)

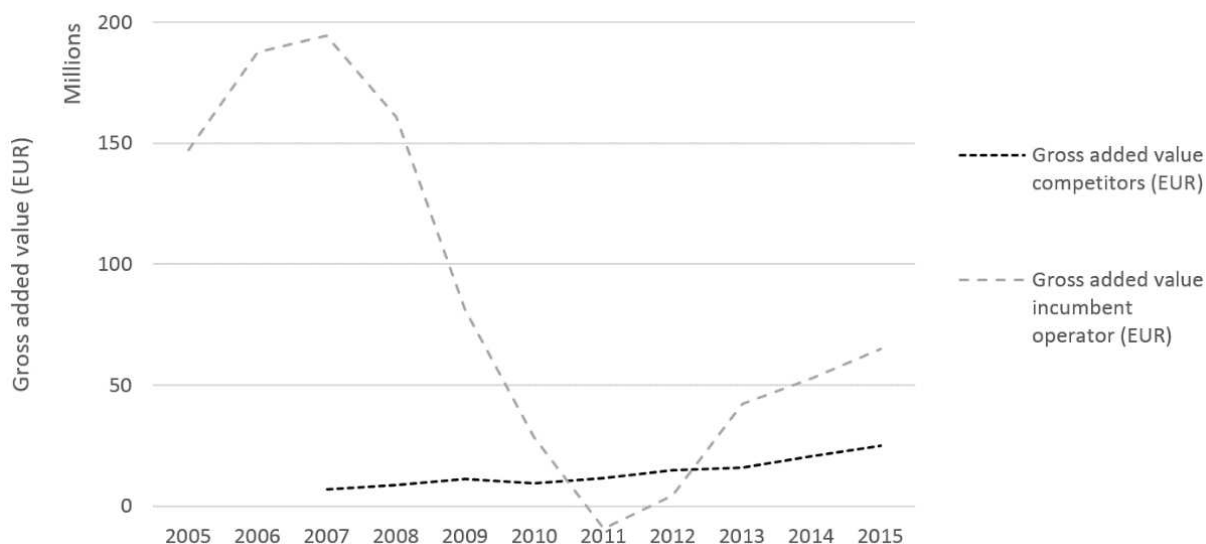
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370 3.3. Comparison with the competition

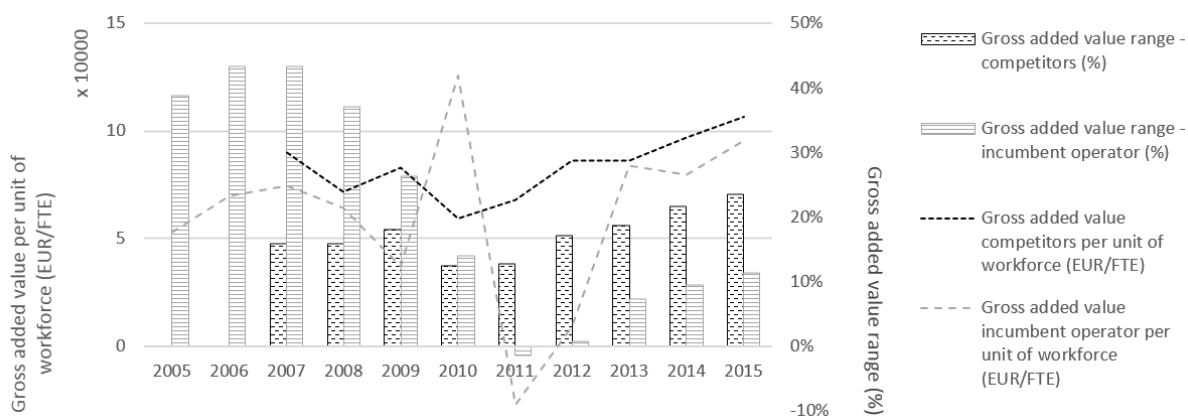
371 Although only limited data is available for the competitive rail freight operators in Belgium, it is still interesting
 372 to observe what is accessible to bring some insights by comparing available data of the incumbent rail freight
 373 operator and its main competitors. Therefore, the simplified top-down approach will be used to estimate the
 374 aggregated gross added value in factor prices for the four main competitors within the observed period: Captrain
 375 Belgium (2008 – 2016), Crossrail (2007 – 2016), Railtrax (2008 – 2015) and Transport (2008 – 2016). Although
 376 no production values are available, an aggregated market share of 15% can be estimated due to the use of
 377 revenue. Liberalization in Belgium started in 2007, making it possible to calculate the gross added value for the
 378 competitors as from this year. Figure 7 shows the comparison of the gross added value between the incumbent
 379 rail freight operator and the aggregated value for the main competitors. A clear and stable positive trend can be
 380 observed, although the aggregated total of competitors remains well under the absolute value of the incumbent
 381 rail freight operator, leaving the transition period out of consideration.
 382

383 The aggregated gross added value of the main competitors and the observed data on employment and revenue of
 384 these competitors can be used to calculate two out of three economic indicators (1) (3), and compare them with
 385 the results observed for the incumbent rail freight operator. This is shown in figure 8. Although the aggregated
 386 absolute gross added value of the main competitors is lower compared to the incumbent rail freight operator, the
 387 indicator of added value per unit of workforce (1) shows a clear advantage of the competitors over the incumbent
 388 rail freight operator. This supports the idea that competitors indeed targeted the high added value flows of the
 389 incumbent rail freight operator. Therefore competitors succeed in a more efficient or productive strategy to
 390 generate added value with a limited amount of labour. Looking at the indicator trend for the competitors, a
 391 similar positive evolution can be observed, indicating that liberalization has started to generate surplus effects in
 392 terms of added value creation within the rail freight sector. Looking at the other indicator, the gross added value

393 range (3), competitors are more vertically integrated with values up to more than 20%. This again indicates that
 394 competitors are better able to capture their own supply chain and generate a higher amount of gross added value
 395 relative to their revenue. Here also a similar positive trend can be observed. It can be concluded that competition
 396 is generating a positive economic impact, as not only competitors are running rail freight services more
 397 productively compared to the incumbent rail freight operator, but they are also stimulating the incumbent rail
 398 freight operator to improve its efficiency by rethinking its remaining business. In addition, the positive trends for
 399 all indicators show that a margin for further improvement still exist for all rail freight operators.
 400



401 Figure 7 Comparison of gross added value (simplified top-down approach) between incumbent rail freight operator and main competitors
 402 Source: own composition based on SNCB (1990 - 2009), B Logistics group (2011 - 2016), Captrain (2008 - 2016), Crossrail (2007 - 2016),
 403 Railtraxx (2008 - 2015) and Trainsport (2008 - 2016)
 404



405 Figure 8 Comparison of added value per unit of workforce and added value range between the incumbent operator and the competitors
 406 Source: own composition based on SNCB (1990 - 2009), B Logistics group (2011 - 2016), Captrain (2008 - 2016), Crossrail (2007 - 2016),
 407 Railtraxx (2008 - 2015) and Trainsport (2008 - 2016)
 408

409 In further research, the analysis performed in this study for the rail freight sector can also be applied to its main
 410 competitors for hinterland transportation-, as well as other incumbent operators in neighbouring countries. As the
 411 modal shift would imply that road transport shifts to rail and/or inland waterways, and as rail transport is often
 412 seen as a solution within the intermodal chain where road transport executes the pre- and post-haulage, the added
 413 value creation and economic indicators within these sectors are an interesting contribution. Although this is out
 414 of the scope of this study, a first step towards future research is made by applying the simplified top-down
 415 methodology to a limited number of road transport companies operating in Belgium, comparable to the observed
 416 rail freight operator (revenue and workforce). Data was obtained from the annual accounts of these
 417 organisations. These rough calculations indicate that similar added value and economic indicator values are

418 obtained for both sectors, with also an increasing trend for the road sector. Nevertheless, further research with
419 more extensive data and a larger representation of the Belgian road sector should be performed to confirm these
420 results. For inland waterways, it is concluded that the sector is characterized by small family businesses owning
421 often only one+ barge. As they are often represented by agents, it could be a solution to check if their data can be
422 used to represent the sector of inland waterways. Some first rough calculations similar to the road sector learn
423 that inland waterways generate a very high amount of added value with only limited workforce. As such, the
424 economic indicator is higher compared to rail and road, however the sector seems to face a downward trend.
425 Again, further research is necessary to validate these first indications.
426

427 4. Conclusion

428 This paper analysed different ways to approach the direct economic impact of rail freight transport activities on
429 the Belgiana national economy-. Four different approaches to calculate gross added value in factor prices at
430 company level were introduced and data were collected to calculate these figures for a specific case found in the
431 incumbent rail freight operator in Belgium. Due to the absence of freight-allocated historical data, the main focus
432 of this research was on the period 2010 – 2015, in which the incumbent rail freight operator became an
433 independent organization. In addition to the calculation of the gross added value in factor prices, three economic
434 indicators were observed, being the added value per unit of workforce, the added value per unit of production
435 and the added value range. These economic indicators make it possible to better understand the relation between
436 added value generation and the production values in tkm, the necessary employment to generate this production
437 and the obtained revenue from the production. Although data collection proved to be challenging, as public data
438 is scarce and fragmented, some interesting conclusions can be drawn from this research.

439 Contribution to managerial practice and policy

440 First, historic data shows that no joint cost allocation took place before liberalization of the freight activities in
441 Belgium. Therefore the incumbent rail company was not able to clearly indicate which costs and revenues were
442 to be allocated to the freight or passenger services. It can be concluded that such a division proves to be crucial
443 for companies with multiple services, in order to be able to evaluate the economic relevance of each independent
444 service.

445 Second, it is indicated that the importance of intermodal activities is showing an increasing trend for rail freight
446 transport in Belgium. Furthermore, the results are showing clear positive trends in terms of economic indicators
447 and economic impact for both the incumbent rail freight operator, as well as the main competitors in Belgium.
448 Although the incumbent rail freight operator was confronted with some difficult transition years, impacted on by
449 the financial and economic crisis and the increase of market competition targeting the high added value
450 businesses, all Belgian rail freight operators can show positive added value figures and rising trends for the
451 economic indicators. Therefore, it can be concluded that rail freight operators have indeed evolved into more
452 than just an executor of rail freight transport movements. By generating an increasing added value, rail freight
453 might slowly grow further in modal share and providing as such provide growing employment opportunities, rail
454 freight slowly grows in market share, in the field of locally trained train drivers and byground personell staff for
455 stations. By doing so has, rail freight transport can continue to have a rising impact on the Belgian economy,
456 with more value added generated. Given the geographical location of the Belgian case study, as well as the
457 limited territory of Belgium, it could be interesting to see if these results also apply for other international
458 incumbent operators. A similar methodology could be adopted on foreign data available. In the current state of
459 data, it is observed though that each country applies its own method of annual reporting, with different
460 terminologies or definitions used. This would mean that some 'translation' and regrouping of input data would
461 be needed if application in other countries is considered. This is a The research question that can also be
462 addressed in a macro-economic study of the impact of rail freight transport on a national economy, where
463 sectoral employment would might prove to be one of the key input parameters. In a next step, the rail freight
464 market should continue to focus on innovation and strategies to continue this positive evolution and increase its
465 profitability.

466 Third, it is clear from this research that the market share of the incumbent operator is still high. Therefore, there
467 is a need for a strong regulator, that on behalf of the government safeguards competition, so as to ensure socially
468 optimal investments and operations. Such regulatory activity should also ensure that maxium efficiency is sought
469 after and enough innovation is present in operations.

470 Contribution to scholarly knowledge

471 With respect to scholarly knowledge, it is shown that the approach taken in this study allows calculating the
472 value added of specific sub-sectors in the economy, and link it to developments in the overall economy, as well
473 as to use it for efficiency calculation purposes.

474 ~~It~~ is first of all observed that data is scarce and often not publicly available as of 2010, due to the fear for
475 competition. Nevertheless, this research shows that data is crucial for academic research in order to build a
476 strong case for the further development of the rail freight industry. Without this data, it is impossible to generate
477 the impact of freight activities and as such defend its case. In addition it is also crucial that data and statistics are
478 maintained in a uniform way, allowing comparison over a long period of time.

479 Furthermore, this research is mainly built on the direct impact of rail freight transport in Belgium, with a strong
480 focus on added value and the labour factor at company level. Not only will it be interesting to see the further
481 evolution of these parameters over the next years, but also the factor capital should be included in the form of
482 investments in rail freight transport developments. Equally, also the indirect effects of the rail freight transport as
483 a sector on the Belgian economy should be evaluated.

484 Further studies should also include similar evaluations for road transport and IWW. By doing so, it would be
485 possible to compare the economic impact of rail freight services with those other land transport modes.
486 Nevertheless, specific characteristics of each mode will have to be taken into account when evaluating the
487 economic indicators. [A key element in such analysis will again be the availability of suitable statistical data,
488 which is a point of attention for policymakers, as good market analysis is the basis of suitable policymaking.](#)

489 **Availability of data and material**

490 Most datasets used and/or analysed during the current study are available from the corresponding author on
491 reasonable request. Restrictions apply to the availability of data that was used under license for the current study,
492 and so are not publicly available. This data is however available from the authors upon reasonable request and
493 with permission of Lineas.

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